SPORT BALL WITH SELF-CONTAINED INFLATION MECHANISM HAVING PRESSURE INDICATION

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 60/404,889, filed on August 21, 2002.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to sport balls that contain mechanisms for inflating or adding pressure to the balls. The inflation mechanisms additionally have integral pressure indicators.

[0003] Conventional inflatable sport balls, such as basketballs, footballs, soccer balls, volleyballs and playground balls, are inflated through a traditional inflation valve using a separate inflation needle that is inserted into and through a self-sealing inflation valve. A separate pump, such as a traditional bicycle pump, is connected to the inflation needle and the ball is inflated using the pump. The inflation needle is then withdrawn from the inflation valve that self-seals to maintain the pressure. This system works fine until the sport ball needs inflation or a pressure increase and a needle and/or pump are not readily available.

[0004] In conventional sport balls, there is no easy way to determine the pressure of the ball. Some pumps have a pressure indicator on them. Alternatively, a separate pressure-indicating device may be used to determine the pressure. Surface pressure indicating devices are also well known.

SUMMARY OF THE INVENTION

[0005] The present invention provides a sport ball that has a self-contained inflation mechanism or multiple self-contained inflation mechanisms, and the inflation mechanisms have integral pressure indicating devices. The object is to be able to inflate or add pressure to a sport ball without the need for separate inflation equipment such as a separate inflation needle and pump, and to be able to determine the pressure of the ball. Specifically, the invention relates to a sport ball that has at least one self-contained pump device which is operable from outside the ball and which pumps ambient air into the ball to achieve the desired pressure. Additionally, the pump has an integral pressure indicator to determine the relative pressure of the ball.

[0006] Other objects of the invention will become apparent from the specification, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] A sport ball with a self-contained inflation mechanism having pressure indication embodying the features of the present invention is depicted in the accompanying drawings which form a portion of this disclosure and wherein:

[0007] Figures 1A and 1B show a cross section of a portion of a sport ball with a self-contained piston and cylinder arrangement with an integral pressure indicating device. In Figure 1A, the piston is pushed down (position 1). In Figure 1B, the piston is pulled up (position 2);

[0008] Figure 2 is a side view of the piston shown in Figures 1A and 1B;

[0009] Figure 3 is an isometric view of the cap for the pump of Figures 1A and 1B showing the configuration for locking and unlocking the pump piston;

[0010] Figure 4 is a detailed cross-section view of a one-way valve assembly for use on the exit of the pump of Figures 1 and 1B;

[0011] Figure 5 is a cross-section view of an entire sport ball illustrating a pump on one side and a traditional inflation valve on the opposite side including a counterweight; and

[0012] Figure 6 is a sectional view of the pump assembly of the present invention having a pressure indicating device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Referring to Figures 1A to 6 of the drawings, a portion of a sport ball **10** is illustrated incorporating an inflation pump of the invention. The ball **10** illustrated in these figures is a typical basketball construction comprising a carcass having a rubber bladder **12** for air retention, a middle layer **14** composed of layers of nylon or polyester yarn windings wrapped around the bladder and an outer rubber layer **16**. For a laminated ball, an additional outer layer **18** of leather or a synthetic material comprises panels that are applied by adhesive and set by cold molding. The windings of the middle layer **14** are randomly oriented and two or three layers thick, and they form a layer that cannot be extended to any significant degree and that also restricts the ball **10** from expanding to any

significant extent above its regulation size when inflated above its normal playing pressure. This layer **14** for footballs, volleyballs and soccer balls is referred to as a lining layer and is usually composed of cotton or polyester cloth that is impregnated with a flexible binder resin such as vinyl or latex rubber. The outer layer **18** may be stitched for some sport balls **10**, such as a soccer ball or a volleyball. The outer layer **18** may optionally have a foam layer backing **16** or a separate foam layer.

[0014] Other sport ball constructions, such as sport balls produced by a molding process, such as blow molding, may also be used in the invention. For an example of a process for molding sport balls, see, for example, U.S. Patent No. 6,261,400, incorporated herein by reference.

[0015] Materials suitable for use as the bladder **12** include, but are not limited to, butyl, latex, urethane, and other rubber materials generally known in the art. Examples of materials suitable for the winding layer include, but are not limited to, nylon, polyester and the like. Examples of materials suitable for use as the outer layer **18**, or cover, include, but are not limited to, polyurethanes, including thermoplastic polyurethanes; polyvinylchloride (PVC); leather; synthetic leather; and composite leather. Materials suitable for use as the optional foam layer include, but are not limited to, neoprene, SBR, TPE, EVA, or any foam capable of high or low energy absorption. Examples of commercially available high or low energy absorbing foams include the CONFOR™ open-celled polyurethane foams available from Aearo EAR Specialty Composites, Inc., and NEOPRENE™ (polychloroprene) foams available from Dupont Dow Elastomers.

[0016] Incorporated into the carcass of the ball **10** of the invention during the formation is the rubber pump boot or housing **20** with a central opening **21** and with a flange **22** which is bonded to the bladder **12** using a rubber adhesive. The boot **20** is located between the rubber bladder **12** and the layer of windings **14**. The boot **20** may be constructed of any suitable material, such as butyl rubber, natural rubber, urethane rubber, or any suitable elastomer or rubber material known in the art, or combinations thereof. A molding plug (not illustrated) is inserted into the boot opening during the molding and winding process to maintain the proper shape central opening and to allow the bladder to be inflated during the manufacturing process. The molding plug is preferably aluminum, composite or rubber, most preferably aluminum. The central opening **21** through the boot **20** is configured with a groove **24** to engage a pump cylinder **28**, and more specifically to hold a flange **26** on the upper end of the pump cylinder **28**. The pump cylinder **28** can optionally be bonded to the boot **20** using any suitable flexible adhesive (epoxy, urethane, cyanoacrylate, or any other flexible

adhesive known in the art). The pump cylinder **28** shown is a right cylinder, but other cylinders that are not right cylinders, such as a cylinder having a non-circular cross-section, may be used.

[0017] Located in the pump cylinder **28** is the pump piston **30** that is illustrated in Figures 1A and 1B. The pump piston **30** may include a circular groove **32** at the bottom of the piston **30** housing a spring **34**, with the spring **34** forcing the piston **30** in the cylinder **28** toward the outer layer **18** of the ball **10**. However, in one embodiment of the pump **11** described below, the spring **34** is not necessary to force the pump piston **30** up in the pump cylinder **28**.

[0018] Also at the bottom end of the piston **30** is an O-ring groove **36** containing the O-ring **38**. As seen in Figure 1A, this O-ring groove **36** is dimensioned such that the O-ring **38** can move up and down in the groove **36**. The O-ring **38** is forced into the position shown in Figure 1A when the piston **30** is pushed down. In this position, the O-ring **38** seals between the cylinder wall and the upper flange **40** of the groove **36**. As shown in Figure 2, there are recesses or slots **42** in the groove **36** extending from just below the upper flange **40** down through the lower flange **44**. Only one of these slots **42** is shown in Figure 2 but there are preferably two or more. When the piston **30** is forced up by the spring **34**, the O-ring **38** moves to the bottom of the groove **36** which opens up a by-pass around the O-ring **38** through the recesses **42** so that the air can enter the cylinder **28** below the pump piston **30**. Then, when the pump piston **30** is pushed down, the O-ring **38** moves back up to the top of the groove **36** and seals to force the air out through the cylinder exit nozzle **46**.

[0019] At the upper end of the piston **30** are the two flanges **48** that cooperate with the cylinder cap **50** to hold the piston down in the cylinder **28** and to release the pump piston **30** for pumping. The cylinder cap **50** is fixed into the top of the cylinder **28** and the piston **30** extends through the center of the cylinder cap **50**. The cap **50** is cemented into the cylinder **28** using a suitable adhesive, such as a UV cured adhesive. Figure 3 shows an isometric view of the bottom of the cylinder cap **50** and illustrates the open areas **52** on opposite sides of the central opening through which the two flanges **48** on the piston **30** can pass in the unlocked position. In the locked position, the piston **30** is pushed down and rotated such that the two flanges **48** pass under the projections **54** and are rotated into the locking recesses **56**.

[0020] Attached to the upper end of the piston **30** is a button or cap **58** that is designed to essentially completely fill the hole **21** in the carcass. In some embodiments, such as a basketball or football, the button or cap **58** is preferably flush or essentially flush with the surface of the ball **10**. In other embodiments, such as a soccer ball, the button or cap **58** is preferably below the surface.

This button **58** may be of any desired material. Examples of materials suitable for use as the button or cap **58** include urethane rubber, butyl rubber, natural rubber or any other material known in the art. A preferred rubber for use as the button or cap is a thermoplastic vulcanizate such as SANTOPRENE™ rubber, available from Advanced Elastomer Systems, Akron OH. The button or cap **58** should match the feel of the rest of the ball **10**. Its surface may be textured to increase grip if desired, such as for a basketball. For a soccer ball, the surface may be smooth.

[0021] In a preferred embodiment, fibers or other reinforcing materials may be incorporated into the rubber compound or thermoplastic material during mixing. Examples of fibers materials suitable for use include, but are not limited to, polyester, polyamide, polypropylene, Kevlar, cellulistic, glass and combinations thereof. Incorporation of fibers or other reinforcing materials into the button or cap **58** improves the durability of the button **58** and improves the union of the button or cap **58** and the piston rod **30**, thus preventing the button or cap **58** from shearing off during use. Although the pump would still function without the button **58**, it becomes very difficult to use.

[0022] Preferably, the button or cap **58** is co-injected with the piston **30** as one part. Alternatively, the button or cap **58** may be co-injected with a connecting piece, and the button or cap **58** and connecting piece may then be attached to the upper end of the piston **30** using an adhesive suitable for bonding the two pieces together. Co-injecting the button **58** and the piston **30** as one part, or alternatively, the button **58** and the connecting piece as one part that is mounted to the piston, provides a more durable part that is less likely to break or come apart during routine use of the ball. The button or cap material and the piston material need to be selected such that the two materials will adhere when co-injected. Testing of various combinations has shown that co-injecting or extruding a soft rubber button, such as a button comprising SANTOPRENE™, and a harder piston, such as polycarbonate or polypropylene and the like, provides a durable bond without the need for adhesives.

[0023] The piston **30** and the connecting piece may be formed of any suitable material, such as, but not limited to, polycarbonate (PC), polystyrene (PS), acrylic (PMMA), acrylonitrile-styrene acrylate (ASA), polyethylene terephthalate (PET), acrylonitrile-butadiene styrene (ABS) copolymer, ABS/PC blends, polypropylene (preferably high impact polypropylene), polyphenylene oxide, nylon, combinations thereof, or any suitable material known in the art. Materials with high impact strength are preferred. The material used for the piston **30** is preferably substantially clear or transparent to

allow the pressure indicating device **72** to be viewed by the user, although a translucent material may be incorporated as well.

[0024] Looking to Figure 1A, a pad **60** is mounted on the upper surface of the cylinder cap **50**. The pad **60** is engaged by the button **58** when the piston **30** is pushed down against the spring force to lock or unlock the piston **30**. The pad **60** provides cushioning to the pump and should also be flexible to match the feel of the rest of the ball.

[0025] Figures 1A and 1B of the drawings shows a pump exit nozzle **46** but does not show the one way valve that is attached to this exit. Shown in Figure 4 is one preferred embodiment of a one-way valve assembly **62** of the duckbill-type to be mounted in the exit nozzle **46**. This assembly comprises an inlet end piece **64**, an outlet end piece **66** and an elastomeric duckbill valve **68** captured between the two end pieces **64**, **66**. The end pieces **64**, **66** are preferably plastic, such as a polycarbonate, polypropylene, nylon, polyethylene, or combinations thereof, but may be any material suitable for use. The end pieces **64**, **66** may be ultrasonically welded together. Any type of one-way valve known in the art may be used, as long as it prevents air from flowing out of the interior of the ball **10** when not desired.

[0026] A pump assembly **11** of the type described and illustrated in Figures 1A to 6 is preferably made primarily from plastics such as polystyrene, polyethylene, nylon, polycarbonate and combinations thereof, but it can be made of any appropriate material known in the art. Although the assembly is small and light weight, perhaps only about 5 to about 25 grams, a weight may optionally be added to the ball structure to counterbalance the weight of the pump mechanism **11**. In lighter weight or smaller balls, such as a soccer ball, the pump assembly **11** may weigh less and/or be smaller (shorter) than a corresponding pump assembly for a heavier ball, such as a basketball.

[0027] Figure 5 illustrates such a counterbalance arrangement wherein a pump mechanism generally designated **82** is on one side of the ball and a standard needle valve **84** is on the opposite side of the ball. In this case, the material **86** forming the needle valve **84** is weighted. Additional material can be added to the needle valve housing or the region surrounding the valve. Alternatively, a dense metal powder such as tungsten could be added to the rubber compound.

[0028] Looking further to Figure 6, the piston **30** may be fashioned to have a hollow shaft made of a substantially clear or translucent polycarbonate material, such that the piston **30** is able to house a pressure indicating device **72**. A series of pressure indication lines **70** are further marked on the

piston **30** such that the position of the pressure indicating device **72** will allow the user to determine the air pressure within the game ball **10**. The pressure indicating device **72** of the present invention may take various forms, such as a ball or a slide. In the embodiment illustrated in Figure 6, the pressure indicating device **72** includes a gage puck **76** that is attached to a gage piston **74**. A gage spring **73** is further positioned within the piston **30** between the gage piston **74** and the button **58**. The gage spring 73 is calibrated such that it will apply a predetermined resistance against the gage piston **74**. The piston **30** further includes a shaft end piece 77 holds the O-ring **38** and further serves to hold a tube or needle **78** extending from the hollow piston **30** to the area enclosed by the cylinder **28**. At the end of the cylinder **28** opposite the piston **30** is a pierced rubber check valve **82**, which is identical to check-valves that are used in a conventional sport balls such as basketballs.

[0029] The piston **30** illustrated in Figure 6 operates as described above to pump air into the game ball **10**. Additionally, the piston **30** of the present invention allows the user to check the air pressure within the sport ball **10** by simply depressing the button **58** into the sport ball **10**. In particular, the force of the button **58** will drive the piston **30** through the cylinder **28** toward the rubber check valve **82**. As the shaft end piece 77 moves toward the rubber check valve **82**, the needle **78** will traverse a centering guide **80** and engage the rubber check valve **82**. The needle **78** will pass through the check valve **82** to engage the center area of the sports ball **10**, thereby providing a conduit for the air within the ball **10** to escape into the piston **30**. The force of the air exiting the ball **10** will drive the gage piston **74** against the calibrated spring **73**, and the gage puck **76** will concomitantly move toward the button **58**. Consequently, the gage puck **76** will move proximate the pressure indication lines **70**, which are calibrated to accurately indicate the pressure of the air within the ball **10**. The air pressure will additionally operate to push the piston **30** from the cylinder **28** and toward the outer layer **18** of the ball **10**, thereby assisting the user in sliding the piston **30** past the outer layer **18**. The user will then be able to monitor air pressure within the ball **10** by viewing the gage puck **76** through the substantially transparent or translucent piston **30**. It should also be noted that the best measurement is provided when the length of the piston **30** is in a substantially horizontal position.

[0030] Once the user has read the measurement, the piston **30** may be reinserted and locked in the cylinder **28** as described above. The gage spring **73** will further apply pressure to the gage piston **74** to return the gage piston **74** to a resting position.

[0031] It should further be noted that in the position shown in Figure 1A, air is allowed to escape the ball **10** and show the pressure by positioning the pressure indicating device **72** in a relative position that corresponds to pressure indication lines **70**. One way of achieving this is to allow the one-way valve **66** to be opened by the needle **78** of the pump **11**. This allows air to escape from the interior of the ball **10** and actuate or move the pressure indication device **72** in the pump piston **30** due to air flowing through it and exiting the ball **10**. In the position shown in Figure 1B, the user will be able to view the corresponding air pressure and then force air into the ball **10** as the piston **30** is driven back into the cylinder **28**.

[0032] The description thus far and the drawing Figures 1A to 6 disclose a particular and one preferred pump arrangement. However, other pump arrangements can be used within the scope of the invention. Examples of other pump arrangements that may be used with the invention are shown in co-pending Application Serial Nos. 09/594,980, filed June 15, 2000; 09/594,547, filed June 14, 2000; 09/594,180, filed June 14, 2000; and 09/560,768, filed April 28, 2000, incorporated herein by reference.

[0033] Since the pressure in a sport ball **10** can be too high through over-inflation or a temperature increase, or too low through under-inflation or air loss, it is an advantage to have a pressure-indicating device that is integral to the pump **11**. If the pressure is too low, additional air may be added using the self-contained pump **11** of the invention. If the pressure is too high, the pressure may be relieved by bleeding pressure from the ball **10** with the conventional inflating needle (not illustrated) or other implement that will open the conventional inflation valve to release air. The pressure-indicating device **72** of the present invention may then be used to determine if the ball **10** is correctly inflated. If too much air is removed, additional air may be added using the pump **11**.

[0034] The foregoing description is, at present, considered to be the preferred embodiments of the SPORT BALL WITH A SELF-CONTAINED INFLATION MECHANISM HAVING PRESSURE INDICATION. However, it is contemplated that various changes and modifications apparent to those skilled in the art may be made without departing from the present invention. Therefore, the foregoing description is intended to cover all such changes and modifications encompassed within the spirit and scope of the present invention, including all equivalent aspects.